Satellite-based Near Real-time Assessment of Water Requirement of California Crops

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Introduction

A common method for estimating crop water requirement is multiply daily reference or potential evapotranspiration (ETo) calculated from meteorological parameters by a crop coefficient (Kc) to obtain actual or crop ET or ETc for a particular crop at a particular stage of growth (Fig. 1). Generic Kc values are available for many California crop types through websites or published documents (Fig. 2) but they usually lack the temporal resolution for practical applications.

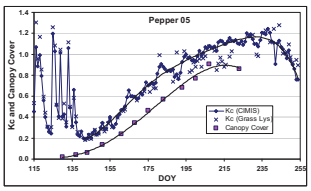


Fig. 1. Daily Kc of bell pepper and canopy cover.

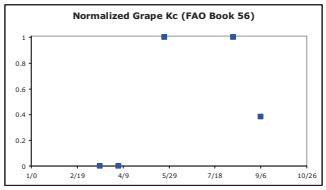


Fig. 2. FAO Kc for grapes – five points/season.

An intended application for the ETc assessment is irrigation scheduling (time and amount). Crop responses can be reflected in stem water potential (SWP, Fig. 3) where a comparison is made between furrow (F1, F2) and subsurface drip (S1, S2). While the method is straightforward to apply, such standard time-based Kc profiles can be unreliable due to variations in crop conditions, site suitability, and climatic variability. Consequently, adoption of climate based irrigation scheduling in California is low. A near real-time determination of water status of crops on the ground is not available for California farmers.

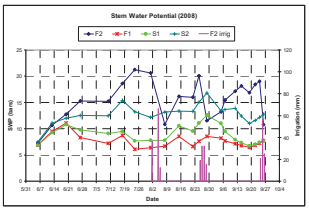


Fig. 3. Stem water potential under managed irrigation.

Objective

The objective of this research was to develop and demonstrate a prototype decision support system that can efficiently deliver crop coefficient and estimated crop water use information to agricultural producers and water suppliers.

Methods and Procedures

Steps of Computing ETc:

Step I: for all crops
Canopy Cover = a* NDVI + b

Step II: crop specific
Kc = m*Canopy Cover + n

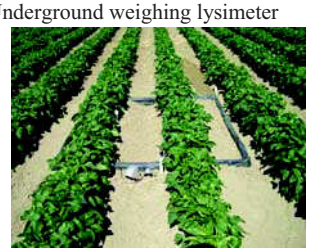
Step III: crop specific
ETc = Kc*ETo

Where a, b, m, n are fitted empirical parameters.

Study Area:
West Side of San Joaquin Valley of California

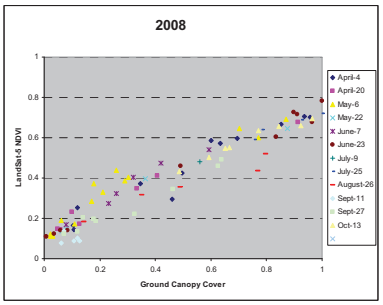
Canopy Cover
- Ground-based measurement, TetraCam

Kc Estimates
– Underground weighing lysimeter

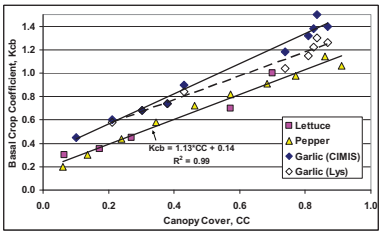


Preliminary Results

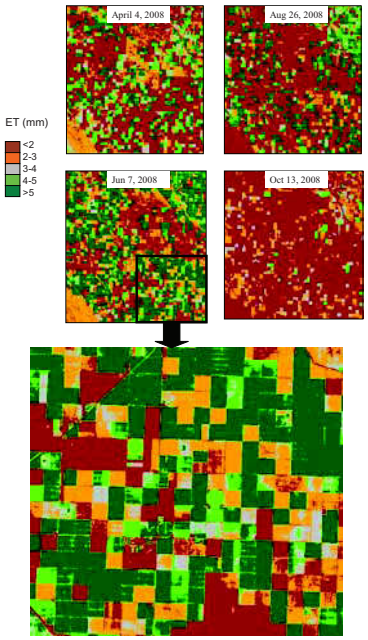
STEP I: NDVI to Canopy Cover



STEP II: Canopy Cover to Kc



STEP III: Kc to ETc (using ETo)



Summary and Challenges

The initial results are promising, challenges are:

- Validation with eddy covariance/BR
- Improved accounting for soil evaporation and stomatal regulation
- Farmer adoption

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